Admission to hospital with gastroenteritis

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Abstract
A prospective study over a one year period examined preadmission illness and its treatment, social characteristics and referral patterns, and inpatient illness progression in 1148 children admitted with a primary diagnosis of gastroenteritis. Admissions were predominantly from socially disadvantaged families: 712 (62%) from social classes IV and V. Approximately a quarter were referred with minimal symptoms, only 12 (1%) with moderate to severe dehydration, and eight (<1%) with hypernatraemia. One hundred and ninety two of 1101 (17%) had not seen their general practitioner during the acute illness. One third had received no treatment and one third inappropriate antibiotics, antidiarrhoeals, antiemetics, or changes of milk.

Gastroenteritis is a less severe illness than formerly but remains a significant cause of paediatric morbidity. Suboptimal treatment is common. Improved local district hospital and community based resources are needed.

In 1978, 142 infants and 22 toddlers (1 to 4 years old) died from gastroenteritis in England and Wales.[1] In 1980 and 1986 these figures were respectively 45 and 14, and 21 and 6.[2] [3] A similar substantial fall in mortality is recorded in the United States.[4] Gastroenteritis remains, however, a significant cause of childhood morbidity in the developed world.[4–6] In the United Kingdom there has been little change in the incidence of gastroenteritis recorded in general practice,[7] [8] with at least 10% of children affected in each of the first two years of life, or in the number of children with gastroenteritis admitted to hospital.[5] [9–11] In 1967 there were approximately 16 000 paediatric admissions with gastroenteritis in England and Wales. In 1985 this figure was 17 000 (S Gopel, personal communication). The illness is, however, milder.[10–13] Not only is there no decrease in the total number of paediatric admissions with gastroenteritis, but the number admitted without signs that might be expected to concern the primary care physician is actually increasing.[10]

The aim of this study was to document the paediatric population admitted with gastroenteritis to a subregional infectious disease unit over a one year period, in order to determine if the trend towards increasing admission numbers, milder illness, and admission biased towards socially disadvantaged families has continued.[9–11] By characterisation of the family's background and the course of the illness before admission and while in hospital we hoped to be able to understand the dynamics of the doctor–parent–patient interaction that has produced this pattern.

Patients and methods
A one year prospective study, July 1986 to June 1987, included all admissions under 16 years of age referred with a diagnosis of gastroenteritis, as defined by the referring doctor. Children referred with other diagnoses but believed by the admitting doctor to have a primary gastroenteric illness were included in the study population when gastroenteritis was confirmed by observation and other diagnoses excluded by relevant investigations. At admission the age, sex, height, and weight of the child were recorded. Details of the history before admission were documented, including duration of diarrhoea, frequency and consistency of stool, number of contacts with the general practitioner, manner of referral to hospital, treatment before admission, and presence of vomiting or any other symptoms. The social history included parental age, employment, marital status, social class, and the standard and type of housing.

On admission all children were clinically assessed for dehydration.[9] Routine investigations included full blood count and plasma urea and electrolyte concentrations. Faecal samples were collected on three successive days from most patients and examined according to standard methodology for salmonella, shigella, and Campylobacter spp, cryptosporidia, enteropathogenic Escherichia coli, and rotavirus. Further faecal samples were sent in cases of continuing diarrhoea and examined for the presence of cysts of Giardia lamblia and for Clostridium difficile and its toxin where appropriate. Stool frequency was recorded daily and stool consistency noted by nursing staff as constipated, normal, loose, very loose, or watery. The time to cessation of diarrhoea was defined as 24 hours after the last fluid stool. Cows' milk protein intolerance was clinically diagnosed on the grounds of delayed recovery (continued or relapsing diarrhoea on the reintroduction of milk feeds with or without vomiting and failure to thrive, and settling after exclusion of cows' milk from the diet).[14]

Antibiotics were prescribed only when indicated by the presence of invasive salmonella infection, Shigella spp, giardiasis, or C difficile and its toxin. Erythromycin was prescribed for Campylobacter spp gastroenteritis if symptoms persisted at the time of positive identification of the bacteria. Antidiarrhoea and antiemetic drugs were not used. All children less than 1 year of

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age routinely received glucose electrolyte solution (Dextrolyte, Cow and Gate) for 24 hours and were then regraded through half strength and three quarter strength to full milk feeds. One hundred and fifty infants who were simultaneously taking part in a trial of feeding practice in the management of gastroenteritis received immediately on admission either SMA Gold Cap (Wyeth), Formula S (Cow and Gate), or Milupa HN 25.[15] The data were analysed by the χ^2 tests, *t* test, analysis of variance, Mann-Whitney test, and the Kruskal-Wallis one way analysis of variance by ranks as appropriate. All the data were collected on most patients. We do not believe the missing data affect the results.

Results

A total of 1148 patients were entered into the study, 639 (56%) boys and 509 (44%) girls, $p<0.001$. Patient characteristics are shown in table 1. A total of 424 (37%) were <6 months of age and 635 (53%) <1 year of age. The proportion of boys was similar in each age group. Eighty (7%) children were below the third centile for weight. One hundred and seventy one (15%) mothers and 667 (58%)

fathers were employed. Ninety three families (8%) had established social worker involvement and 101 (9%) were first or second generation immigrants. One hundred and twelve (11%) described their housing as unsatisfactory.

MONTH OF ADMISSION

Significantly more children were admitted between October and March (n=667) than between April and September (n=481), $p<0.001$. This was attributable to the increased number of children aged 0.6 to 1.3 years admitted in autumn and winter (n=336) compared with spring and summer (n=185) reflecting the increased prevalence of rotaviral infection: 251 compared with 108 admissions respectively.

PREADMISSION HISTORY (TABLE 2)

(i) Length of history
The mean length of diarrhoea before admission was five days. There was no association between the length of diarrhoea before admission and parental age, single parent or not, immigrant family or not, or father employed or not. Children of working mothers were admitted significantly earlier in their illness, mean 3.8 days, than those of non-working mothers, mean 5.2 days, $p<0.025$, as were children of higher compared with lower social class families, $p<0.05$.

(ii) Stool frequency and consistency
The mean frequency of stools/day before admission was 5.9. Relatively more children with diarrhoea subsequently shown to be of bacterial, protozoal, or mixed pathogen aetiology (53, 36%) had a frequency of stool >7/day, compared with those with rotaviral infection (89, 26%), and those from whom no pathogen was isolated (124, 20%), $p<0.001$. There was a significant difference in the mean frequency of stool/day according to pathogen, with rotaviral diarrhoea and diarrhoea from which no pathogen was subsequently identified having a relatively low stool frequency, $p<0.001$. Diarrhoea of bacterial, protozoal, or mixed aetiology had a relatively high incidence of stool containing blood or mucus, or both, than rotaviral diarrhoea or cases with no identified pathogen, 25% compared with 2.8% and 4.1% respectively, $p<0.001$.

Table 1 Characteristics of study population

	No (%)
Age (years):	
0–0.5	424 (37)
0.6–0.9	211 (18)
1.0–1.9	310 (27)
2.0–4.9	147 (13)
5.0–9.9	43 (4)
≥10.0	13 (1)
Total	1148
Social class:	
I	14 (1)
II	115 (10)
III	307 (27)
IV	193 (17)
V	519 (45)
Total	1148
Parental marital status:	
Married	886 (78)
Cohabiting	69 (6)
Separated	67 (6)
Single with family support	62 (5)
Single with no family support	51 (5)
Total	1135
Accommodation:	
Council	628 (60)
Own house	381 (36)
Private rented	26 (3)
Homeless	12 (1)
Traveller	5 (<1)
Total	1052

Table 2 Preadmission history

Duration of illness		Mean length of illness (days) according to social class		Mean frequency of stools/day		Mean frequency of stools/day according to pathogen		Stool consistency		Vomiting	
No of days	No (%) children	Class	No of days	Mean frequency	No (%) children	Pathogen	Mean frequency	Type of stool	No (%) children	Pathogen	No (%) children
0–1	278 (24)	I	3.6	0–1	67 (6)	None identified	5.6	Soft/loose	293 (26)	None identified	487 (77)
1.5–2.5	173 (15)	II	3.4	2–3	243 (22)	Rotavirus	5.9			Rotavirus	328 (92)
3.0–5.5	413 (36)	III	4.9	4–7	529 (48)	Protozoa	6.1	Very loose/watery	765 (68)	Protozoa	16 (84)
6.0–8.5	143 (13)	IV	4.7	8–11	175 (16)	Bacteria	7.4	Bloody mucus	73 (6)	Bacteria	63 (54)
≥9	135 (12)	V	5.6	≥12	91 (8)	>One pathogen	7.7			>One pathogen	12 (75)
Total	1142				1105				1131		906/1143

(iii) Associated symptoms

Rotaviral infection was significantly associated with vomiting before admission (328, 92%) and with respiratory symptoms (86, 24%), p<0·001 when compared with gastroenteritis of other aetiology. Abdominal pain was more common in bacterial diarrhoea (22, 17%) than in diarrhoea of other aetiology (69, 7%), p<0·001.

(iv) Referral patterns

There was no association between the number of times a child was seen by his general practitioner and the social class or employment state of the parents, single parenthood, immigrant background, or degree of dehydration on admission. Children <1 year of age were more likely to be seen on two or more occasions (300, 50%) than children >1 year of age (127, 25%), p<0·001, and less likely to receive one or less visits: 298 (50%) compared with 376 (75%), p<0·001. The time of referral to hospital was documented in 1064 admissions. The majority, 822 (77%), were referred between noon and midnight, 69 (7%) between midnight and 6 am. A relatively high proportion of the latter (25, 36%) compared with those admitted between 6 am and midnight (156, 16%) had never been seen by their general practitioner, p<0·001. There was no association between the time of referral and parental social class, single parenthood, or severity of diarrhoea. There was no association between social class and the agency referring the child to hospital. The number of children referred with a history of two days or less was relatively high for those who were already inpatients in other hospitals (48, 67%), compared with all other admissions (399, 37%), p<0·001. Similarly patients referred from other hospitals or from casualty departments had a relatively higher incidence of mild diarrhoea, less than four stools/day (96, 34%), and consistency of stools described as soft or loose (93, 32%), compared with those referred by general practitioners: 210 (26%) and 197 (24%) respectively, p<0·001.

FINDINGS ON ADMISSION

A total of 245 (21%) patients were febrile. One hundred and one (9%) were dehydrated, 89 (8%) <5%, 11 (1%) 5% to 10%, and one >10%. Dehydrated patients were subsequently more likely to have a gut pathogen identified than

well hydrated patients: 62 (61%) compared with 449 (43%), p<0·001, as were febrile compared with non-febrile patients: 140 (57%) and 368 (41%) respectively.

Plasma sodium concentrations were recorded in 1119 admissions. Hypernatraemia (plasma sodium >149 mmol/l) was found on eight occasions and was significantly associated with rotaviral infection (six cases, p<0·05). Clinical dehydration was associated with a relatively low bicarbonate concentration (<21 mmol/l), relatively high urea concentration (>7 mmol/l), plasma sodium concentration >145 mmol/l, and with fever (table 3).

INPATIENT HISTORY

(i) Intravenous rehydration

Sixty two (5%) children received intravenous fluids. There was no association between the need for intravenous rehydration and treatment before admission. Patients in whom a pathogen was subsequently identified were more likely to have received intravenous fluids than cases in which no pathogen was identified, 40 (8%) of 512 compared with 22 (3%) of 636, p<0·01.

(ii) Course of illness

The average number of diarrhoeal stools/day in hospital during the period of acute illness was 1·6, and was relatively low for diarrhoea from which no pathogen was isolated compared with rotaviral gastroenteritis, and relatively high for diarrhoea of bacterial, protozoal, or mixed aetiology, p<0·001 (table 4). The diarrhoea settled in a mean 64·9 hours, and did so within 48 hours for a relatively high proportion of cases from whom no pathogen was isolated, within 49 to 96 hours for a relatively high proportion of rotaviral cases, and continued for longer than 96 hours in a relatively high proportion of cases of bacterial, protozoal, or combined aetiology, p<0·001 (table 5). Twenty eight (3%) children

Table 3 Factors associated with dehydration

	No (%) with no dehydration (n=1047)	No (%) with dehydration (n=101)	p Value
Sodium >145 mmol/l	6 (<1)	11 (11)	<0·001
Bicarbonate <21 mmol/l	576 (55)	73 (72)	<0·001
Urea >7 mmol/l	56 (5)	30 (30)	<0·001
Temperature >37°C	211 (20)	34 (34)	<0·005

Other symptoms		Seen by general practitioner		Treatment		Referral	
Symptom	No (%) children	No of times	No (%) children	Type of treatment	No (%) children	Route	No (%) children
None	717 (63)	0	192 (17)	None	384 (34)	General practitioner	714 (63)
Respiratory	262 (23)	1	482 (44)	Oral rehydration solution	354 (31)	Casualty	208 (18)
Abdominal pain	91 (8)	2	302 (27)	Antibiotics	85 (7)	Doctors' deputising service	133 (12)
Rash	28 (24)	3	85 (8)	Antidiarrhoeal/antiemetic	50 (4)	Other hospital ward transfer	74 (6)
Fits	15 (1)			Calpol	35 (3)	Self referral	12 (1)
Other	35 (3)	≥4	40 (4)	Change of milk	12 (1)		
				Combination of above	228 (20)		
	1148		1101		1143		1141

Table 4 Average number of diarrhoeal stools/day. Results are number (%)

Average stool frequency /day	Stool culture		
	No pathogen isolated	Rotavirus	Bacteria, protozoa, or combined infections
0–1	368 (61)	165 (49)	41 (28)
1·5–2·5	127 (21)	100 (29)	32 (21)
2·5–3·5	66 (11)	38 (11)	32 (21)
≥4	39 (7)	36 (11)	44 (30)

Table 5 Length of diarrhoeal illness in hospital. Results are number (%)

Time to settle (hours)	Stool culture		
	No pathogen isolated	Rotavirus	Bacteria, protozoa, or mixed infections
0–48	399 (67)	173 (52)	57 (39)
49–96	96 (16)	106 (32)	44 (30)
≥97	97 (16)	52 (16)	46 (31)

required a second period of glucose electrolyte solution. There was no association between the perceived need for a further period of glucose electrolyte solution and stool culture results. Thirty three (3%) had clinically diagnosed cows' milk protein intolerance.

(iii) Time to discharge

The mean length of inpatient stay was seven days. A relatively high proportion (52%) of children with rotavirus gastroenteritis were discharged within five days compared with those with bacterial, protozoal, or mixed infection (30%), $p<0·001$. A relatively high proportion of those with bacterial, protozoal, or mixed infection required 12 days or more in hospital: 27 (18%) compared with 76 (8%) for diarrhoea of other aetiology, $p<0·001$. Relatively fewer patients of social class V (29%) were discharged within five days compared with social classes I to IV (44%), $p<0·001$, as were children of single parents without family support (10%) compared with others (38%), $p<0·001$. Time to discharge was also relatively longer for patients with social worker involvement.

(iv) Readmissions

Fifty one patients were readmitted once, four twice, and one three times. Thirty three (59%) readmissions were social class V families and 10 (18%) from each of classes IV and III. Seventeen (30%) were within one week of the previous admission and 27 (48%) within 14 days. Twenty nine (52%) readmissions were mainly attributable to poor social circumstances. In no case was early readmission necessitated by severe gastroenteritis.

STOOL EXAMINATION AND DIAGNOSTIC CONCLUSIONS

Stool examination identified rotavirus in 359 (31%) cases, *Salmonella* spp in 54 (5%), *Campylobacter* spp in 37 (3·2%), enteropathogenic

E coli in 21 (2%), crytosporidia in 16 (1%), giardia in four (<1%), *Shigella* spp in three (<1%), *C difficile* in two (<1%) and combinations of the above in 16 (1%). No pathogen was identified in 636 (55%) cases.

Of the 1148 patients in the study, 1053 (92%) were referred as gastroenteritis and this diagnosis was supported by the clinical course in hospital, the absence of other demonstrable pathology and/or the demonstration of a potential gut pathogen from stool examination. Twenty seven (2%) were referred with a diagnosis other than gastroenteritis but clinical observation in hospital and the absence of other demonstrable pathology suggested gastroenteritis as the primary underlying condition. The referring diagnoses were vomiting cause unknown (n=13), meningitis (n=6), bronchiolitis (n=2), and one case each of pneumonia, whooping cough, septicaemia, measles, upper respiratory tract infection, and otitis media.

In 59 (5%) cases referred with gastroenteritis, diarrhoea or vomiting, or both, they were subsequently believed referrable to other documented pathology: bronchiolitis (n=8), feeding problems (n=8), cows' milk protein intolerance (n=7), pyloric stenosis (n=6), pneumonia (n=6), urinary tract infection (n=6), constipation (n=3), otitis media (n=2). There was one case each of oesophageal reflux, mumps, measles, coeliac disease, Shwachman-Diamond syndrome, cystic fibrosis, post intussusception diarrhoea, sexual abuse, toddler diarrhoea, perforated appendix and pelvic abscess, acute lymphoblastic leukaemia and febrile neutropenia, threadworm infestation, and acute haemolytic anaemia with glucose 6-phosphate dehydrogenase deficiency. In nine (<1%) cases no illness was demonstrated.

Discussion

The predominance of boys and of children less than 1 year of age follows the pattern of previous work.[9–11] The large numbers of infants may reflect parental concern and anxiety for their seemingly vulnerable baby, and/or doctor awareness of how rapidly such young children may deteriorate. This is probably reflected in the increased number of doctor–patient contacts before admission for children less than 1 year of age. There was, however, an impression among the admitting junior staff that the referring doctor often overestimated the clinical severity of the child's condition. Pressure on the primary care physician to request admission may also stem from a lack of parental understanding of the child's condition.[11] Better health education of young mothers, easy access to hospital assessment and outpatient review, with continued general practitioner or health visitor supervision at home, may reduce the need for admission in cases of mild gastroenteritis.

There appears to be little provision for children who develop gastroenteritis while inpatients for other reasons in general paediatric wards. A significantly high proportion of such infants were referred with short duration of diarrhoeal illness with mild diarrhoea. Similar figures were obtained for children referred through casualty

departments, suggesting the lack of isolation facilities in general paediatric wards and reliable community based services with which casualty departments may liaise.

Most admissions were from the lower social classes with 45% from social class V alone. It is likely that these parents without their own transport and with financial restrictions will have most difficulty in visiting or staying with their child in hospital. A total of 60% lived in council accommodation, 11% in unsatisfactory housing, and 16% were single parents. These figures compare with studies in Newcastle[10] and Manchester[11] where only about 10% of admissions were social class I or II families and where the incidence of single parents ranged from 6% to 23%. In Newcastle from 1971 to 1975 only 9% of fathers were unemployed, compared with 42% in the present study. The continued high admission rates may in part reflect poor socioeconomic factors that are associated with increased exposure of susceptible children to enteric infection,[6] poor maternal education, and a failure to make early use of available health care. The mean length of illness before admission for social classes I and V families in this study was 3·6 and 5·6 days respectively.

The need for a reassessment of the management of paediatric gastroenteritis is evident from the preadmission history of the study population. About one quarter of the children were referred with minimal symptoms; one day or less of diarrhoea, <4 stools/day, stools soft or loose in character. Seventeen per cent had never seen their general practitioner and a further 44% on one occasion only. No treatment had been prescribed in one third and inappropriate treatment (antibiotics, antidiarrhoeals, antiemetics, change of milk feeds) in a further third. These findings are consistent with previous work and show a continuation of suboptimal clinical practice. Pullan found 19% of children with a history of less than one day's symptoms in 1971 to 1975 and 41% receiving antibiotics or antiemetics.[10] Wheatley reported widespread use of antibiotics in infantile gastroenteritis in general practice in 1968,[7] Lewis a 30% use in 1977,[16] and Catford, in 1978, found that most undesirable or hazardous prescribing in general practice was for the control of the symptoms of diarrhoea and vomiting.[17] Kumar reported on 288 children with gastroenteritis admitted in 1982–3.[13] Forty one per cent had seen their general practitioner but had no treatment prescribed; 16% had received inappropriate medication; and only 12% had received oral glucose electrolyte solutions. Ellis found 40% of his study population in 1982 who had never seen their general practitioner, 70% had never received glucose electrolyte solutions, and 55% had received inadequate fluid volume at home.[11] Twenty six per cent had received antidiarrhoeals and 18% inappropriate antibiotics.[11]

Children admitted to hospital with gastroenteritis are generally well nourished. Only 7% in this study were less than the third centile for weight. The vast majority of these children will recover with glucose electrolyte solutions alone[18] and may need only a continuation of normal feeds.[15] The basis of management should be a proper attention to fluid balance. There is no evidence to support the use of antimotility or antisecretory agents.[19] Kaopectate (Upjohn) may make the stool look more formed but causes no change in stool frequency, water content, or weight.[20] Antibiotics are only indicated in specific cases; the treatment of invasive salmonella infection, shigella,[21] *G lamblia*, *Campylobacter* spp,[5] or *C difficile*.

Paediatric gastroenteritis is less severe than formerly.[10-13] In this study it generally followed a mild course in hospital and prolonged admission was largely due to poor social circumstances. Moderate to severe dehydration on admission was recorded in 12(1)% children compared with 18% in 1967,[9] 18·6% in 1975,[10] and 14% in 1982.[11] Hypernatraemia was recorded in <1% compared with 14% in 1967,[9] 12·5% in 1975,[10] and 1% in 1982.[11] Intravenous fluids were administered to 5·4% of admissions compared with 28% in 1971–2,[22] and 6·7% in 1982.[11] Clinical cows' milk protein intolerance, which rapidly settled with temporary withdrawal of cows' milk feeds, was diagnosed in 3%. This is in line with a recognised trend in northern Europe,[10 14 23] and probably reflects the low allergenic potential of highly adapted formula milks.

The seasonal pattern of admission with increased numbers in the autumn and winter months reflecting the peak of rotavirus infection in 6 to 18 month old children is consistent with findings in other surveys.[6 9 24 25] Rotavirus infection was also characterised by vomiting before admission, coexistent respiratory symptoms, dehydration, and recovery within a week as previously reported.[16 24] Diarrhoea of bacterial, protozoal, or mixed pathology was likely to produce a greater frequency of stool, the passage of blood and/or mucus, and abdominal pain. Potential pathogens were identified in 45% of admissions; this is a similar distribution to recent studies[10 11 16 24] and shows the predominance of rotavirus and the decreasing importance of enteropathogenic *E coli*.

This study shows that gastroenteritis may initially present with signs and symptoms suggestive of other pathology but more importantly that other, sometimes serious pathology, may present as a primary gastroenteritis. Despite familiarity with children with diarrhoea each case deserves a thorough history and examination. Greater awareness of the dangers of gastroenteritis and the ready availability of oral glucose electrolyte solutions have resulted in a substantial fall in paediatric gastroenteritis related mortality. None the less, children may still die from readily preventable complications of the illness.[4] One might argue that we have to accept the continuing high admission rates for gastroenteritis (which are often clinically mild), the family disruption and the potential emotional trauma to the patient, as the price to pay for keeping these deaths to an absolute minimum. We believe our paper shows that this need not be so. Little appears to have been learnt from the important studies we have quoted. Preadmission history shows a continuing over use of inappropriate, and under use of

appropriate treatment. There is a need for increased community based paediatric services and a need to reassess the role of the specialist in caring for these children.

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